Fisheries

Key Points

- All alternatives and the Proposed RMP would increase the potential large wood and small functional wood contribution to streams relative to the current conditions over time.
- Sediment production from road construction and operation would increase by less than 1 percent under all alternatives and the Proposed RMP, and the effects to fish would not differ by alternative. These effects to fish would be short-term and localized and could result from increases in turbidity or deposition of fines in the stream channel substrates affecting habitat in the short term.
- Under the No Action alternative, and Alternatives A and D, and the Proposed RMP, less than 0.5 percent of all perennial and fish-bearing stream reaches in the decision area would be susceptible to shade reductions that could affect stream temperature if the BLM applies thinning in the outer zone of the Riparian Reserve based on current conditions. Under Alternative B and C, approximately 5 percent of all perennial and fish-bearing reaches in the decision area would be susceptible to shade reductions that could affect stream temperature if the BLM applies thinning in the outer zone of the Riparian Reserve based on current conditions. Short-term and indirect non-lethal effects from minor increases in stream temperature could include reduced growth rates, a reduction in juvenile survival, or a reduction in reproductive success.

Summary of Notable Changes from the Draft RMP/EIS

The BLM has expanded the discussion of fish species other than anadromous salmonids and has added an appendix (**Appendix I**), which includes a list of the Bureau Sensitive and Bureau Strategic fish species and maps of the designated critical habitat for ESA-listed anadromous salmonid fish. The BLM has also added explanation that the effects to Essential Fish Habitat designated under the Magnuson-Stevens Fishery Conservation and Management Act would be similar to the effects to designated critical habitat.

Background

Threatened and endangered anadromous fish species in the planning area include:

- Lower Columbia River chinook salmon
- Lower Columbia River coho salmon
- Lower Columbia River steelhead trout
- Columbia River chum salmon
- Upper Willamette River chinook salmon
- Upper Willamette River steelhead trout
- Southern Oregon/Northern California coho salmon
- Oregon Coast coho salmon
- North American green sturgeon
- Pacific eulachon (smelt)

In 2011, National Marine Fisheries Service conducted a formal status review of ESA-listed anadromous salmon and steelhead. The analysis and summaries of that review are incorporated here by reference (USDC NMFS 2011). Oregon Coast coho salmon and Southern Oregon/Northern California Coho salmon were not included in that analysis. Of the six anadromous salmon and steelhead in the planning area that were analyzed in that review, none warranted a change in the biological risk category from the previous review in 2005. The Lower Columbia coho has a biological risk assessment of in danger of extinction, and the remaining five species are likely to become endangered.

The National Marine Fisheries Service has designated critical habitat for seven of the eight ESA-listed anadromous salmonid species within the planning area (**Table 3-41** and **Appendix I**). Critical habitat is not mapped for Southern Oregon/Northern California Coho salmon; however, steelhead trout distribution provides a surrogate. The National Marine Fisheries Service has published recovery plans for Lower Columbia River chinook, Lower Columbia River steelhead, Lower Columbia River coho, Upper Willamette chinook, Upper Willamette steelhead, and Southern Oregon Northern California coho salmon (USDC NMFS 2011, 2013, and 2014) and has developed a Proposed ESA Recovery Plan for the Oregon Coast coho salmon (USDC NMFS 2015). The U.S. Fish and Wildlife Service has published recovery plans for bull trout (USDI FWS 2014) and the Lost River sucker and shortnose sucker (USDI FWS 2013).

Recovery plans for ESA-listed fish include the identification of limiting factors for each recovery unit and include recommendations for recovery actions. Limiting factors for the eight anadromous salmonid species include temperature, spawning and rearing habitat, and off-channel habitat.

Table 3-41. Federal Register notices for listing status, critical habitat designation, and ESA protective regulation for ESA-listed anadromous fish in the planning area.

<table>
<tr><th>Species</th><th>Listing Status</th><th>Critical Habitat</th><th>Protective Regulation</th></tr>
<tr><td>Lower Columbia River chinook salmon</td><td rowspan="3">June 28, 2005; 70 FR 37160</td><td rowspan="5">September 02, 2005; 70 FR 52630</td><td rowspan="7">June 28, 2005; 70 FR 37160</td></tr>
<tr><td>Upper Willamette River chinook salmon</td></tr>
<tr><td>Columbia River chum salmon</td></tr>
<tr><td>Lower Columbia River steelhead trout</td><td rowspan="2">January 05, 2006; 71 FR 834</td></tr>
<tr><td>Upper Willamette River steelhead trout</td></tr>
<tr><td>Lower Columbia River coho salmon</td><td rowspan="2">June 28, 2005; 70 FR 37160</td><td>January 14, 2013; 78 FR 2726</td></tr>
<tr><td>Southern Oregon/Northern California coho salmon</td><td>May 05, 1999; 64 FR 24049</td></tr>
<tr><td>Oregon Coast coho salmon</td><td>June 20, 2011; 76 FR 35755</td><td colspan="2">February 11, 2008; 73 FR 7816</td></tr>
<tr><td>Pacific eulachon</td><td>March 18, 2010; 75 FR 13012</td><td>October 20, 2011; 76 FR 65324</td><td>June 28, 2005; 70 FR 37160</td></tr>
</table>

Threatened or endangered resident fish species in the planning area include:

- Bull trout
- Lost River sucker
- Shortnose sucker

The amount of critical habitat for ESA-listed non-salmonid fish species or resident salmonid fish species on BLM-administered lands is less than 5 percent of all critical habitat for fish in the decision area (**Table 3-42**). A total of 3.6 miles of bull trout (*Salvelinus confluentus*) critical habitat occur on BLM-administered lands within the Coastal and Klamath recovery units, comprising less than 0.1 percent of bull trout critical habitat. The reintroduction of bull trout in the Clackamas River constitutes a nonessential experimental population and does not have any adjacent BLM-administered lands. Bull trout require colder temperatures and tolerate fine sediment less than most other salmonids in the planning area, and are therefore more sensitive to changes in temperature and sediment. Despite this greater sensitivity, bull trout are affected by the same key ecological processes as the ESA-listed anadromous salmonids in the decision area, allowing them to be analyzed together at this scale of analysis.

Table 3-42. ESA-listed fish species (other than anadromous salmonids) with miles and percent of critical habitat on BLM-administered lands.

Species	Critical Habitat (Miles)	Critical Habitat on BLM-administered Lands in the Planning Area (Miles)	Critical Habitat on BLM-administered Lands in the Planning Area (Percent)
Bull trout (*Salvelinus confluentus*)	4,954	3.6	< 0.1%
Shortnose sucker (*Chasmistes brevirostris*)	135	9.0	6.6%
Lost River sucker (*Deltistes luxatus*)	145	-	-
Pacific eulachon (*Thaleichthys pacificus*)	335	0.12	< 0.1%
Green sturgeon (*Acipenser medirostris*)	1,107	0.07	< 0.1%

The southern distinct population segment (DPS)[51] of green sturgeon (*Acipenser medirostris*) occurs in lower reaches of coastal rivers and estuaries and has limited interaction with BLM-administered lands. Critical habitat for green sturgeon extends in to the lower Columbia River, Nehalem Bay, Yaquina Bay, Winchester Bay, and Coos Bay. The only interaction between green sturgeon critical habitat and BLM-administered lands is a boat ramp on the Coos Bay District.

Similarly, the southern DPS of Pacific eulachon (*Thaleichthys pacificus*) is limited to ocean and lower estuary use and the interaction with BLM-administered lands is very limited. Critical habitat for eulachon extends in to the lower Umpqua River and Tenmile Creek along the Oregon coast. Less than 0.1 percent of the critical habitat for each species is adjacent to BLM-administered lands (**Table 3-42**).

Because of the very limited distribution of the southern DPS of green sturgeon and the southern DPS of Pacific eulachon in the decision area, the BLM would have very limited ability to affect these fish through land management actions. There is no reasonable basis upon which the BLM could predict any difference in these potential effects among the action alternatives, the No Action alternative, or the Proposed RMP on the southern DPS of green sturgeon and the southern DPS of Pacific eulachon or their critical habitat. Any effects on the southern DPS of green sturgeon and the southern DPS of Pacific eulachon or their critical habitat would result from very limited site-specific implementation actions within or affecting the very limited distribution of the southern DPS of green sturgeon and the southern DPS of Pacific eulachon in the decision area. The BLM cannot forecast any such possible effects at this scale of analysis, and would address any such effects in project-specific analyses.

In addition to fish species listed under the Endangered Species Act, the BLM has designated Bureau Sensitive and Bureau Strategic fish species in the decision area. There are ten Bureau Sensitive fish species, evolutionarily significant units (ESUs), or distinct population segments (DPSs) within the decision area and one Bureau Strategic fish species. **Appendix I** lists these species, ESUs, or DPSs. Based on BLM Manual 6840, the BLM shall address Bureau Sensitive species and their habitats in land use plans and shall implement measures to conserve these species and their habitats, to promote their conservation, and reduce the likelihood and need for these species to be listed under the Endangered

[51] A distinct population segment (DPS) is a discrete population of a species and the smallest portion of a vertebrate species that can be protected under the Endangered Species Act.

Species Act. Bureau Strategic species are not special status for management purposes (IM-OR-2015-028). The only requirement for this group of species is that information for species sites located during any survey efforts shall be entered into the BLM corporate database. The BLM updates its Special Status Species list on a regular schedule, when state heritage programs publish new rankings or when other information indicates a need. The life history and habitat usage of these Bureau Sensitive and Bureau Strategic fish species are sufficiently similar to ESA-listed fish species to allow them to be analyzed together.

Pacific lamprey (*Entosphenus tridentatus*), though not an ESA-listed species, is a Bureau Sensitive species and is an important fish for Tribes within the planning area. The Pacific lamprey was historically an abundant food source and played an important role in the daily lives of Tribal members. Though complete and accurate counts throughout the range do not exist, anecdotal information suggests the population of Pacific lamprey is declining across its range, from Washington to California (Luzier *et al.* 2009). In 2012, the BLM, along with other states, Federal agencies, and tribes, entered into a conservation agreement for Pacific lamprey with the U.S. Fish and Wildlife Service. The agreement identified 11 regional management units, including the Coastal Oregon Regional Management Unit, which encompasses Pacific lamprey populations in the planning area. Pacific lamprey life history and habitat usage is sufficiently similar to ESA-listed fish species in the decision area to allow them to be analyzed together.

Columbia River chum salmon and Oregon chub, although occurring in the planning area, are not present in streams adjacent to BLM-administered lands, and thus have little to no potential to be affected by BLM management actions. Additionally, the U.S. Fish and Wildlife Service recently removed the Oregon chub from the list of threatened and endangered species because of improvements in the species' status (80 FR 9126).

Several other non-salmonid fish species occur in a relatively small percentage of streams on BLM-administered lands (**Table 3-42**). These populations, based on the very low interaction with BLM-administered lands, have very little potential to be affected by BLM management actions.

Although a wide variety of other anadromous and resident fish species occur within the planning area, they share similar life histories and habitat requirements. These fish species all spawn in rivers or streams, utilizing clean gravel substrates free of fine sediment, and juveniles spend at least a portion of their lives rearing in pool or off-channel habitat, created primarily by large wood and boulders. For this analysis, the habitat requirements are sufficiently similar to be analyzed together.

Under section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act, the BLM must analyze the effects to Essential Fish Habitat for coho and chinook salmon. Across the decision area, designated critical habitat for ESA-listed species encompasses the vast majority of designated Essential Fish Habitat, and, for the purposes of this analysis, effects on designated Essential Fish Habitat would be similar to the effects on designated critical habitat.

Large wood, stream temperature, sediment, and water flow have the greatest influence on aquatic habitat and the ability of aquatic habitat to support fish populations in the planning area. The abundance and survival of salmonids in the planning area is often closely linked to the abundance of large woody debris in stream channels. The Analysis of the Management Situation (USDI BLM 2013, pp. 32–36) and the 2008 FEIS (USDI BLM 2008, pp. 372–390) provide more detailed explanations of the influence of key ecological processes on fish habitat and fish populations, and those discussions are incorporated here by reference.

The BLM has implemented in-stream fish habitat restoration projects on about 230 miles of fish-bearing streams on BLM-administered lands and on adjacent private lands. This accounts for about 7 percent of fish-bearing streams in the decision area and about 1 percent of all fish-bearing streams in the planning area. The BLM has thinned 17,461 acres forest stands within the Riparian Reserve in the decision area since 1995. This accounts for approximately 2 percent of the 927,721 acres within the Riparian Reserve under the 1995 RMPs. The BLM has implemented much smaller acreages of other silvicultural treatments within the Riparian Reserve, including approximately 1,000 acres of hardwood conversion within the Riparian Reserve since 1995 (USDI BLM Annual Program Summaries 2005–2013). The BLM has removed or replaced 544 stream crossings within the planning area between 1995 and 2012 to allow passage for all life stages of fish at a range of flows (USDI BLM 2008, pp. 390–392; USDI BLM Annual Program Summaries 2005–2007; USDI BLM Aquatic Restoration Biological Opinion II Reporting 2008 to 2012, unpublished). These include removal or replacement of stream crossings on BLM-administered lands or removal or replacement of stream crossings on adjacent private lands in which the BLM worked cooperatively with adjacent landowners and the removal or replacement benefited fish passage on BLM-administered lands.

Under all alternatives and the Proposed RMP, the BLM would continue to remove or replace fish barriers. The rate of removal or replacement would be contingent on funding levels and the ability of the BLM to work cooperatively with adjacent landowners; the BLM has no reasonable basis on which to forecast a difference in funding or opportunities for cooperative work with other landowners. Therefore, the BLM has no reasonable basis for forecasting any difference among the alternatives or Proposed RMP in the amount or rate of removal or replacement of fish barriers. Management direction in all alternatives and the Proposed RMP direct the BLM, when replacing barrier culverts, to install crossings that provide fish passage at a range of flows. For these reasons, the number of crossings and miles of fish habitat opened and the resultant effects on fish habitat would be similar among all alternatives and the Proposed RMP.

Since the adoption of the Northwest Forest Plan, there has been a robust debate about effective riparian management strategies for conservation and recovery of ESA-listed fish. Some reviews have argued that active management in riparian forests results in short-term adverse effects on fish habitat and water quality, and have proposed increased restrictions on active management within the Riparian Reserve to maximize stream shading and the total number of trees available for recruitment to streams (e.g., Frissell *et al*. 2014 and Pollock and Beechie 2014). Other reviews have argued that a reliance of passive restoration will compromise attainment of long-term ecological goals and have proposed more and varied active management approaches within the Riparian Reserve to create larger trees and more complex and diverse riparian forests (e.g., Reeves *et al*. in press).

Frissell *et al.* (2014) is an unpublished report to the Coast Range Association, which provides a collection of policy recommendations and critiques of administrative policies and legislative proposals. Some action alternatives are consistent with some of the recommendations in Frissell *et al.* (2014), such as the prohibiting commercial timber harvest within the Riparian Reserve, which is consistent with the design of Alternative A, and prohibiting livestock grazing in the Riparian Reserve, which is consistent with the design of Alternative D. However, the design of the action alternatives and the Proposed RMP are not consistent with some of the recommendations in Frissell *et al.* (2014), including expanding the size of the Riparian Reserve to protect stream temperature. These policy recommendations and critiques are reflected in the comments summarized in **Appendix W**, which include the BLM response to these recommendations. For those instances in which none of the alternatives or the Proposed RMP are consistent with these recommendations, **Appendix W** details the BLM's explanation of why such recommendations are contrary to the purpose and need for the RMP revision or are not supported by the analysis. Although Frissell *et al.* (2014) presents numerous citations to existing scientific information (many of which are also cited in this section and in the Hydrology section of this chapter), it does not present any new scientific information.

Issue 1

How do the alternatives vary in the contribution of large and small functional wood to fish-bearing and non-fish-bearing streams?

Summary of Analytical Methods

In this analysis, the BLM evaluated the effects of the alternatives and the Proposed RMP on the potential contribution of large and small functional wood to fish-bearing and non-fish-bearing streams at the watershed scale (Hydrologic Unit Code (HUC) 10).[52] The BLM conducted this analysis at the watershed scale, because at finer scales (e.g., individual stream reaches), the BLM would not be able to interpret how changes in the amount of wood available for delivery to streams would affect fish habitat or populations. Wood delivery to individual stream reaches is highly variable, episodic, and unpredictable. Additionally, anadromous fish travel through multiple watersheds along their migrations, and the effects on spawning or rearing habitat would only be discernible once fish reach streams suitable in size for spawning or rearing. This generally occurs in streams at the HUC 10 watershed scale.

The BLM analyzed the potential contribution of wood to streams over time, but did not attempt to model actual wood delivery to streams over time under each alternative and the Proposed RMP. Wood delivery to streams is influenced by myriad factors, including riparian stand conditions, individual tree processes, disturbance events, and geomorphic processes. Many of these influential factors are inherently unpredictable, and several would not be affected by the alternatives or the Proposed RMP. Instead, this analysis, like the 2008 FEIS, evaluated the potential contribution of wood to streams by assessing the condition of forest stands that could potentially deliver wood to streams. The alternatives and the Proposed RMP would directly and substantially affect the condition of these forest stands, and the BLM can more accurately forecast changes to forest stand condition than wood delivery to streams under the alternatives and the Proposed RMP.

The BLM analyzed the potential contribution of wood to streams over 100 years to provide a meaningful comparison of the effects of the alternatives and the Proposed RMP on fish habitat. Wood loading in streams is highly variable, and wood delivery is only one component. Breakdown of wood, large floods, and debris flows can alter the amount or effectiveness of large wood in the stream, and these processes can take place over large spatial scales. Therefore, analyzing the potential contribution of wood to streams over a shorter time period would not accurately compare the effects of alternatives and the Proposed RMP in their ability to affect in-stream fish habitat through wood delivery. The effects of land management to the landscape could take up to 100 years to show any discernable change in the amount or quality of fish habitat created by large or small functional wood.

The ability to analyze the effects of the alternatives and the Proposed RMP on potential wood delivery to streams is limited by several factors, including the data available at this scale of analysis on both stream reach and riparian stand conditions, uncertainties about the extent, location, and timing of riparian stand thinning under each alternative and the Proposed RMP, and the indirect connection between riparian stand conditions and wood amounts in streams. For example, data available at this scale of analysis is not sufficiently site-specific and detailed to evaluate whether the trees in a specific riparian stand are of sufficient size to provide stable instream habitat structure in the specific adjacent stream reach. Instead, the BLM must make generalizations and assumptions, to describe current riparian stand conditions, future riparian stand conditions, and stream conditions. In addition, riparian stand thinning under each

[52] Hydrologic Unit Codes (HUCs) are a U.S. Geological Survey classification based on a hierarchy of nested watersheds.

alternative and the Proposed RMP would affect riparian stand conditions and consequently the wood available for delivery to streams. However, forecasting the extent, specific location, and timing of riparian stand thinning required the BLM to make assumptions about a plausible scenario for implementation under each alternative and the Proposed RMP, adding uncertainty to the effects in any specific location. Finally, the analysis addressed the riparian stand conditions, which identified the wood available for delivery to streams, but actual delivery of wood to streams and consequently, the habitat structure in streams, depends on many factors in addition to riparian stand condition, including stochastic processes, which adds an additional layer of uncertainty to the effects in any specific location.

In this analysis, the BLM assumed that the analytical results in the 2008 FEIS for potential wood contribution provide an approximation of the effects of the alternatives in this analysis. The 2008 FEIS utilized a spatially explicit GIS model to estimate large and small wood delivery to BLM-administered and non-BLM-administered streams for all HUC 10 watersheds within the planning area. The 2008 FEIS analyzed potential large wood and small functional wood contribution to streams considering the effects of forest management and stand growth over time in portions of the landscape capable of delivering wood to streams. That analysis is incorporated here by reference (USDI BLM 2008, pp. 779–797). The Riparian Reserve land use allocation designs and management direction relevant to potential wood contribution for Alternatives B and C in this analysis are roughly comparable to the Riparian Management Area design and management direction in the 2008 Proposed RMP. The Riparian Reserve land use allocation designs and management direction for Alternatives A and D and the Proposed RMP are intermediate between the No Action alternative and the 2008 Proposed RMP. Thus, the analytical results from the 2008 FEIS for the potential wood contribution of the No Action alternative and the 2008 Proposed RMP bracket the effects that would occur under the alternatives and the Proposed RMP in this analysis.

In this analysis, the BLM evaluated the structural stage condition and several forest stand metrics within one site-potential tree height distance of streams. The BLM used one site-potential tree height distance of streams to approximate the area likely to deliver wood to streams. The BLM evaluated four stand metrics:

- The density of large trees (greater than 20” diameter breast height (DBH))
- The percentage of forest stand canopy cover in hardwoods (e.g., red alder and big leaf maple)
- The quadratic mean diameter (QMD) of trees (a weighted average of the size of trees in the stand)
- The number of trees per acre

These metrics provide a broad measure of the potential for forest stands to provide large wood and small functional wood to streams. The BLM used the results of these simpler analyses to validate the assumption that the results from the more complex analysis in the 2008 FEIS for potential wood contribution provides a reasonable approximation of the effects of the alternatives and the Proposed RMP in this analysis.

Background

Woody debris is an important channel-forming component in forested streams in the Pacific Northwest. Wood traps and stores gravel, generates scour that creates pool habitat, provides overhead cover, and protects banks by reducing stream energy. In headwater streams, small wood can retain fine sediment and prevent downstream transport to fish-bearing reaches. Conifer species persist the longest in stream channels. However, hardwood trees, such as red alder and big leaf maple, provide wood, as well as leaf litter, that serve as a nutrient base for macroinvertebrates, which in turn provide food for anadromous fish.

The size of wood that can provide stable structure and induce habitat change in a stream (i.e., functional wood) varies by channel width. Generally, wider streams require larger pieces of wood (Beechie *et al.*

2000, **Table 3-43**). Smaller pieces of wood can also be functional if the stream channel is narrow or if the smaller wood interacts with larger, stable debris jams. Some small instream wood that is not entrained in a debris jam is flushed from the system during high flows. The remaining large pieces of instream wood are depleted at an average rate of 1.5 percent per year (Murphy and Koski 1989). For most streams in the planning area, a 20" DBH tree can provide functional wood in the stream.

Table 3-43. Diameter of functional wood piece as it relates to width of active stream channel.

Width of Stream Channel (Feet)	Diameter of Functional Wood (Inches)
15	4.5
20	6.0
30	9.0
40	12.0
50	15.0
> 50	> 20.0

Trees closer to the stream have a higher probability of falling into the stream. Wood is delivered to stream channels generally from distances less than one site-potential tree height[53] in width from the edge of the active channel (Reeves *et al*. in press). Beyond a distance of one site-potential tree height from the stream, contribution of wood in the form of whole trees is rare and results from episodic debris flows and slope failures. These debris flows result from oversaturation of soils or unstable underlying geology, where large wood along with small wood, boulders, and other substrates can be delivered over longer distances. The 2008 FEIS analyzed land management alternatives using a wood model that accounted for the delivery of wood in the form of whole trees from a variety of sources (USDI BLM 2008, pp. 779–799). That analysis identified three primary sources of instream large wood: riparian tree fall, channel migration, and debris flows (USDI BLM 2008, pp. 376–384, 781–797).

In 2013, the Interagency Regional Executive Team released a series of technical summaries by a Science Review Team on the issue of the effects of riparian thinning and those analyses and findings are incorporated here by reference (Spies *et al.* 2013). The Science Review Team's findings are a compilation of empirical data, relevant studies, and recently modeled wood input. The Science Review Team found that up to 95 percent of instream wood comes from distances ranging from 82 to 148 feet from the edge of the stream bank (i.e., generally less than one site-potential tree height). The primary near-stream inputs of large wood are from tree mortality and bank erosion, along with landslides and debris flows.

Headwater streams that are prone to debris flow delivery can contribute a large proportion of in-stream wood downstream in fish-bearing stream reaches (Benda *et al.* 2003, Reeves *et al.* in press). In these streams, debris flows will capture wood and sediment from the debris flow area and deliver it to streams. May and Gresswell (2004) estimated debris flow recur at an interval of up to 357 years for headwater basins in the Oregon Coast Range.

Riparian tree mortality and subsequent recruitment to streams can represent the primary contribution of large wood in low-gradient meandering streams, while upslope and debris flow contributions can be greatest in higher gradient streams (Reeves *et al.* 2003, Bigelow 2007).

[53] Site-potential tree-heights generally range from 140 feet to 240 feet across the decision area, depending on site productivity.

During the last century, many streams were ‘cleaned’ of large wood to make the downstream transport of harvested logs more efficient. Without large wood to retain gravel and other woody material, many streams were scoured to bedrock and have correspondingly poor habitat for fish. Active restoration to offset the loss of habitat has involved the placement of logs and whole trees in addition to boulders into these bedrock channels. These restorative efforts persist for several decades as riparian stands develop that are capable of supplying long-term sources of wood to streams.

Past timber harvest of riparian stands has resulted in the replacement of structurally-complex stands (with large diameter trees) to young stands (with small diameter trees). These young riparian stands have a preponderance of smaller diameter trees resulting from high tree densities and competition, limiting the ability of these riparian stands to provide functional wood to streams. These young riparian stands are developing at higher densities than the stand conditions under which the existing structurally-complex stands developed (Tappeiner *et al.* 1997, Poage and Tappeiner 2002). The 2008 FEIS described the effects of past harvest on forest stands across the landscape and riparian forest stands specifically (USDI BLM 2008, pp. 202–212, 375–376), and those discussions are incorporated here by reference.

Monitoring results conclude that the ecological condition of approximately two-thirds of the watersheds in the Northwest Forest Plan area have improved in condition in the past two decades. One of the primary factors responsible for this improvement has been the increase in the number of large trees (greater than 20” DBH) within the Riparian Reserve (Reeves *et al.* 2006, Lanigan *et al.* 2012, Miller *et al.* 2015, Reeves *et al*. in press).

Affected Environment and Environmental Consequences

Currently, riparian stands that are within one site-potential tree height of streams average about 316 trees per acre, of which 19 trees per acre are greater than 20” DBH (**Figure 3-42**). Conifers in riparian stands have an average diameter of 8” quadratic mean diameter (QMD). Hardwood trees provide approximately 20 percent of riparian canopy cover. In general, current riparian stand conditions are denser, with smaller diameter trees, than riparian stands historically.

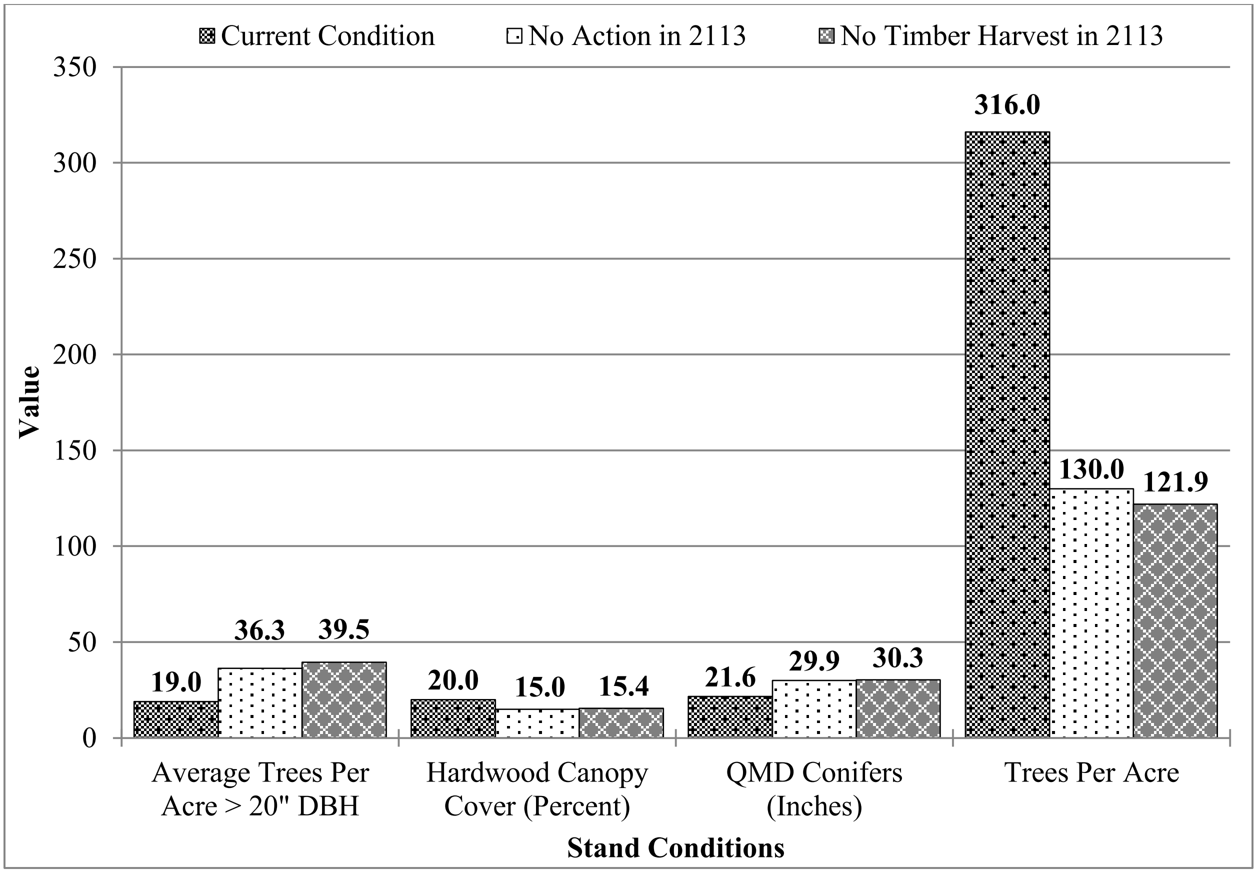

Figure 3-42. Stand conditions within one site-potential tree height for the current condition, the No Action alternative in 2113, and the No Timber Harvest reference analysis in 2113

Stands within one site-potential tree height currently have a relatively even distribution of structural stages with early successional having the least (**Table 3-44**, **Figure 3-43**). Over the next 100 years, the No Action alternative and the No Timber Harvest reference analysis would have a very similar distribution of Young, Mature, and Structurally-Complex stand types, because all stands within one site-potential tree height of streams would be within the Riparian Reserve under the No Action alternative and the BLM would not implement any regeneration harvest which would create new early successional stands.

Table 3-44. Acres in each structural stage for stands within one site-potential tree height from all streams for the current condition and in 2113

Alternative/ Proposed RMP	Early Successional (Acres)	Stand Establishment (Acres)	Young (Acres)	Mature (Acres)	Structurally-complex (Acres)
Current Condition	11,973	139,839	231,555	180,366	208,640
No Action	2	988	39,508	340,841	391,034
Alt. A	-	988	38,807	332,580	399,998
Alt. B	20,800	988	61,785	314,877	373,923
Alt. C	32,570	36,353	74,360	291,095	337,996
Alt. D	-	988	38,420	333,200	399,765
PRMP	1,206	2,148	40,506	335,475	393,038
No Timber Harvest	-	-	39,354	332,784	400,620

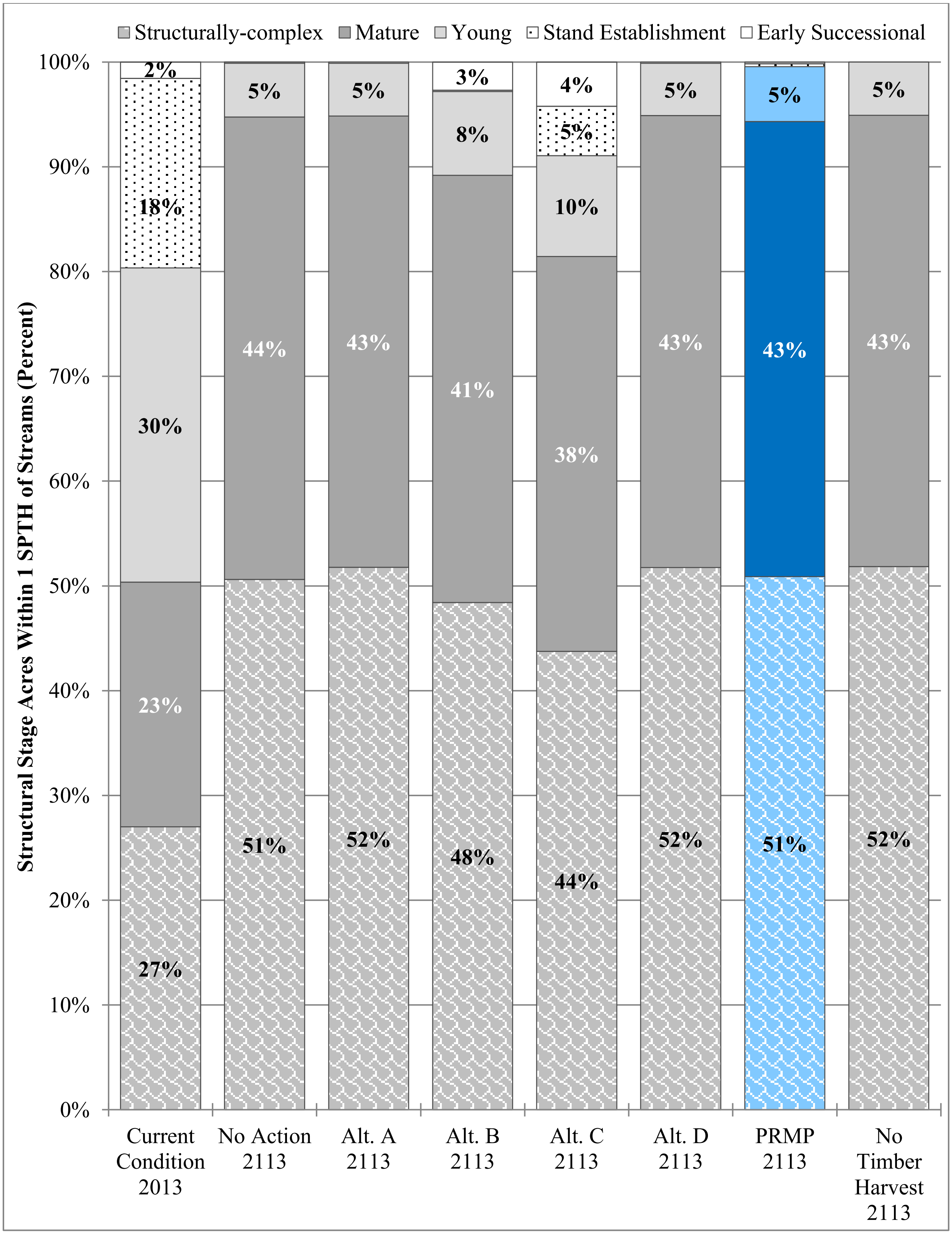

Figure 3-43. Relative proportion of structural stage acres under the current condition, the alternatives, the Proposed RMP, and the No Timber Harvest reference analysis in 2113 for stands within one site-potential tree height from all streams

All alternatives and the Proposed RMP would increase the potential large wood and small functional wood contribution to streams from the current conditions. There is no meaningful difference discernible at this scale of analysis among the alternatives and the Proposed RMP in their effect on overall potential wood contribution. The BLM based this conclusion on the analytical results in the 2008 FEIS for potential wood contribution, which provide an approximation of the effects of the alternatives in this analysis, as discussed above under analytical methods, and that analysis is incorporated here by reference (USDI BLM 2008, pp. 779–797). The 2008 FEIS found that the No Action alternative and 2008 Proposed RMP would have nearly identical effects on potential large wood and small functional wood contribution, and that the potential wood contribution would be only slightly lower than the No Timber Harvest reference analysis. Specifically, that analysis found that potential large wood contribution would increase from the current 5.4 pieces/mile/year to 8.0 pieces/mile/year under both the No Action alternative and the 2008 Proposed RMP and to 8.3 pieces/mile/year under the No Timber Harvest reference analysis in 100 years. Because the analytical results from the 2008 FEIS for the No Action alternative and the 2008 Proposed RMP bracket the effects that would occur under the alternatives and the Proposed RMP in this analysis, and the No Action alternative and 2008 Proposed RMP had indistinguishable effects on potential wood contribution, the alternatives and the Proposed RMP in this analysis would all have the same effects on overall potential wood contribution as those identified in the 2008 FEIS for the No Action alternative and 2008 Proposed RMP.

The relative proportion of structural stages within one site-potential tree height would be similar over time across all alternatives and the Proposed RMP (**Figure 3-43**, **Table 3-44**). The similar proportion of structural stages over time under all alternatives and the Proposed RMP is consistent with the analytical conclusion that the overall potential wood contribution from the alternatives would be similar. Under Alternatives B and C, a higher proportion of those stands within one site-potential tree height would be Early Successional and Stand Establishment. Alternative C has the least acres in the Mature and structurally-complex stand types (i.e., those stands with the most capability to grow and deliver large wood to streams).

All alternatives and the Proposed RMP would increase the number of trees per acre greater than 20 inches DBH near streams from the current condition (**Figure 3-44**). Alternatives A and D would result in a similar increase in the number of large trees near streams, slightly greater than the other alternatives, and only very slightly less than the No Timber Harvest reference analysis. The No Action alternative and Alternatives B and C would result in a smaller increase in the number of large trees near streams. In 20 years, the No Action alternative would result in the least increase in the number of large trees near streams, barely above current levels. In 100 years, Alternative C would result in the least increase in the number of large trees near streams (**Figure 3-45**).

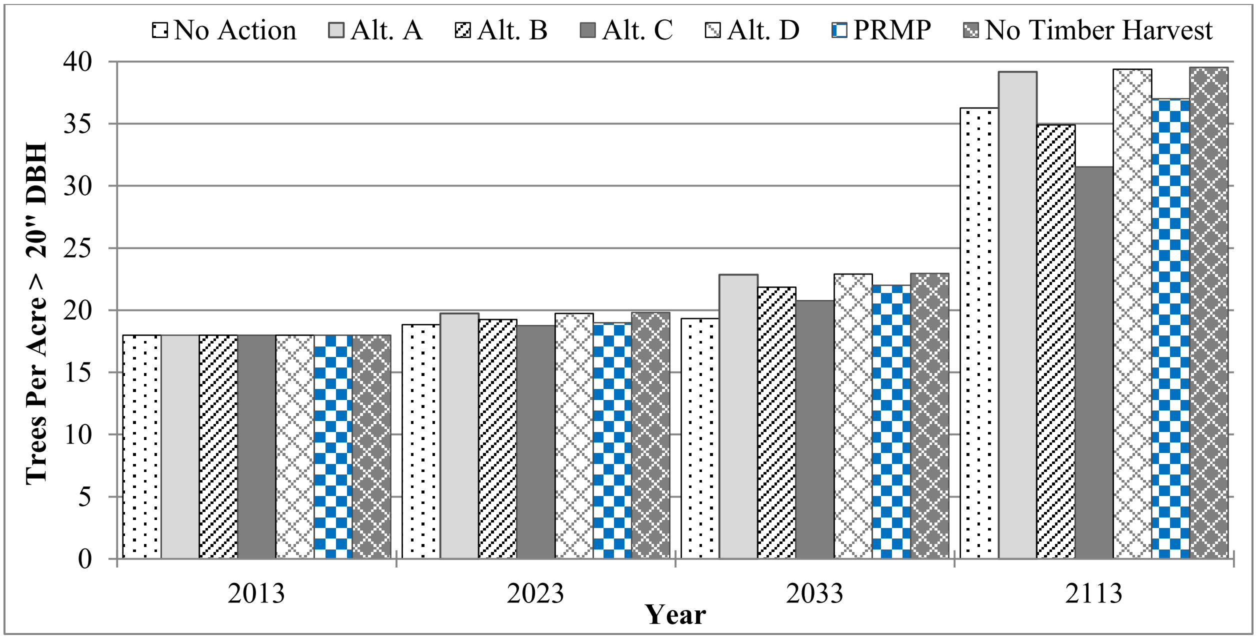

Figure 3-44. Trees per acre greater than 20” DBH within one site-potential tree height over time for all alternatives, the Proposed RMP, and the No Timber Harvest reference analysis

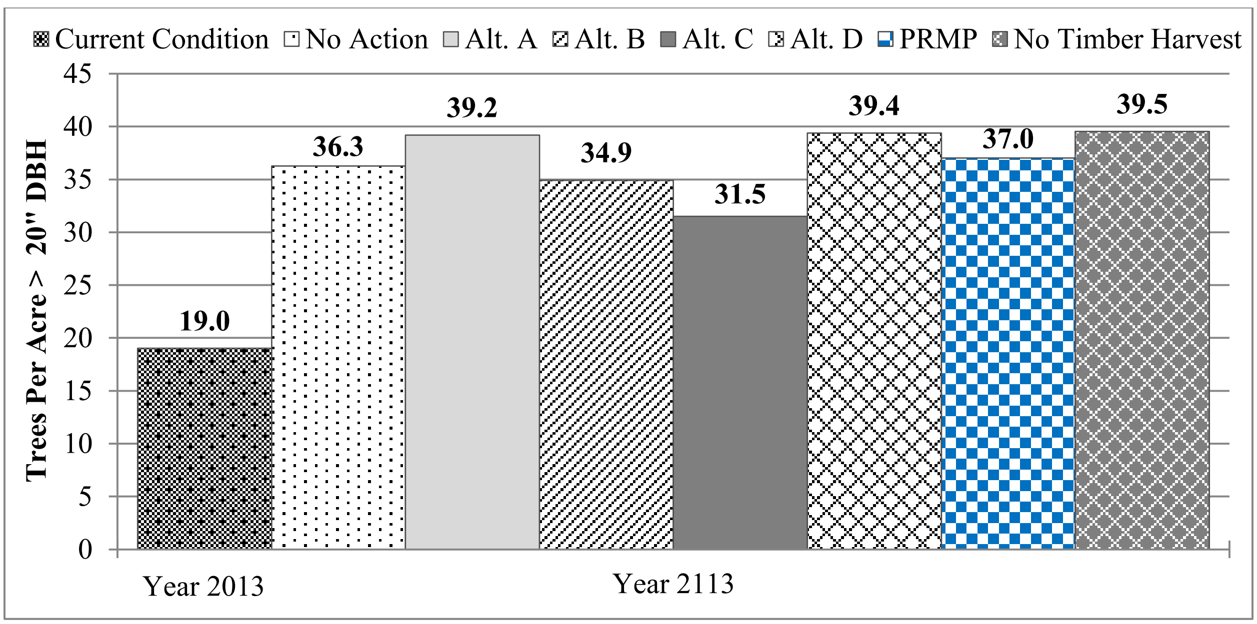

Figure 3-45. Trees per acre greater than 20” DBH for stands within one site-potential tree height of streams for the current condition in 2013, and the alternatives, the Proposed RMP, and the No Timber Harvest reference analysis in 2113

The Proposed RMP would increase the number of trees per acre greater than 20” DBH near streams more than the No Action alternative, Alternatives B and C, but slightly less than Alternatives A and D. As explained in the introduction to Chapter 3, the BLM updated baseline forest age and structural conditions resulting from 2013/2014 wildfires for the analysis of the Proposed RMP, which has resulted in changes to affected environment descriptions throughout this document, when compared to the Draft RMP/EIS.

Because of this updating of the baseline conditions, there is currently a slightly lower (5 percent) current average number of large trees near streams for the Proposed RMP than was analyzed for the action alternatives and No Action alternative. Therefore, this analysis may slightly underestimate the number of large trees near streams for the Proposed RMP compared to the results to the No Action alternative or the action alternatives. Given the very small relative differences among the alternatives and the Proposed RMP, this slight difference in starting conditions could result in a slight underestimate of the number of large trees near streams for the Proposed RMP throughout the analytical time period. Because of similarities in design, the Proposed RMP would have essentially identical effects as Alternatives A and D on the number of trees per acre greater than 20” DBH near streams in Class I and Class II subwatersheds (which constitute approximately 91 percent of the decision area excluding the east side of the Klamath Falls Field Office). In Class III subwatersheds, the Proposed RMP would have effects on the number of trees per acre greater than 20” DBH near streams intermediate between Alternatives A and D, and Alternatives B and C. Thus, while the number of large trees per acre near streams averaged across the decision area would be slightly lower under the Proposed RMP than under Alternatives A and D, it would actually only be lower in a small number of watersheds (< 10 percent of the decision area). In summary, the results shown in **Figure 3-45** display the relative outcomes for large trees near streams over time, but likely overstate the absolute magnitude of the difference in outcomes between Alternatives A and D and the Proposed RMP.

All alternatives and the Proposed RMP would result in a similar decrease in the percentage of canopy cover in hardwoods (**Figure 3-46**).

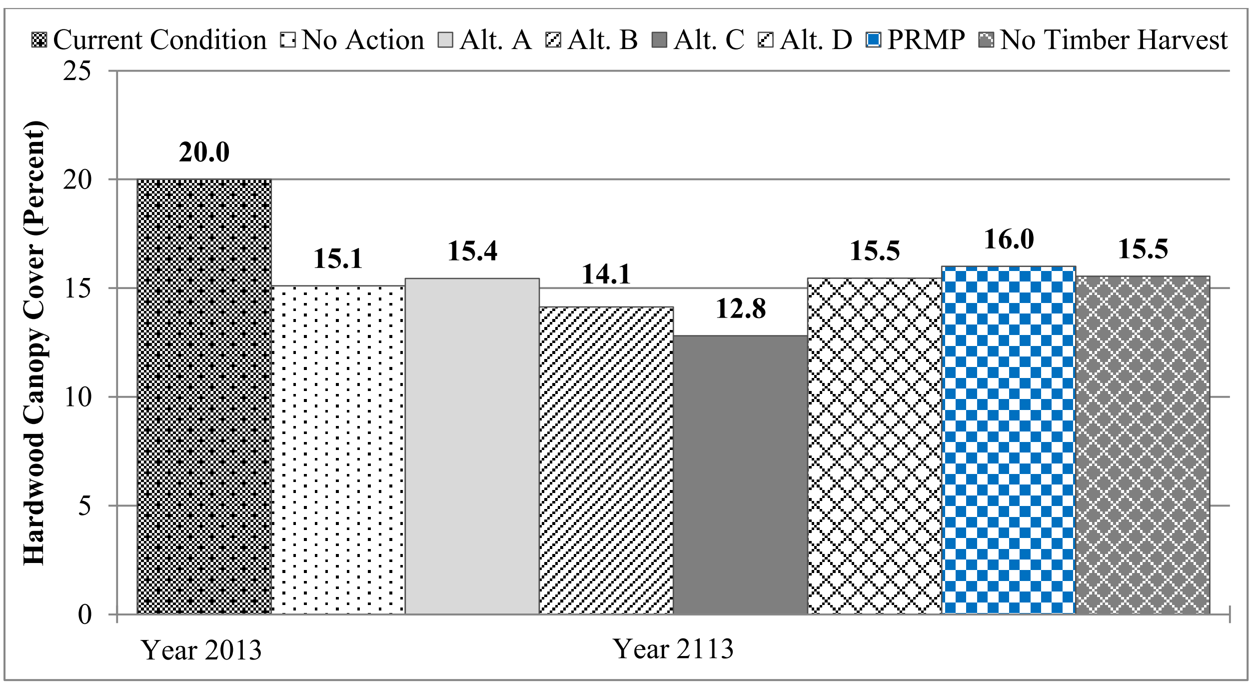

Figure 3-46. Percent hardwood canopy cover for stands within one site-potential tree height of streams for the current conditions in 2013 and in 2113

All alternatives and the Proposed RMP would increase the average diameter of trees in stands within one site-potential tree height of streams (**Figure 3-47**); that increase would be similar under the No Action alternative, and Alternatives A and D, and would be only very slightly less than the increase under the No Timber Harvest reference analysis. Alternative C and Alternative B would result in a smaller increase in the average diameter of trees in stands within one site-potential tree height of streams, reflecting the influence of timber harvest in portions of the Harvest Land Base that are outside of the Riparian Reserve along non-fish-bearing intermittent streams, but within one site-potential tree height of streams. As explained above for the number of large trees near streams, the results shown in **Figure 3-47** display the relative outcomes for the average diameter of trees near streams over time, but likely overstate the absolute magnitude of the difference in outcomes between Alternatives A and D and the Proposed RMP.

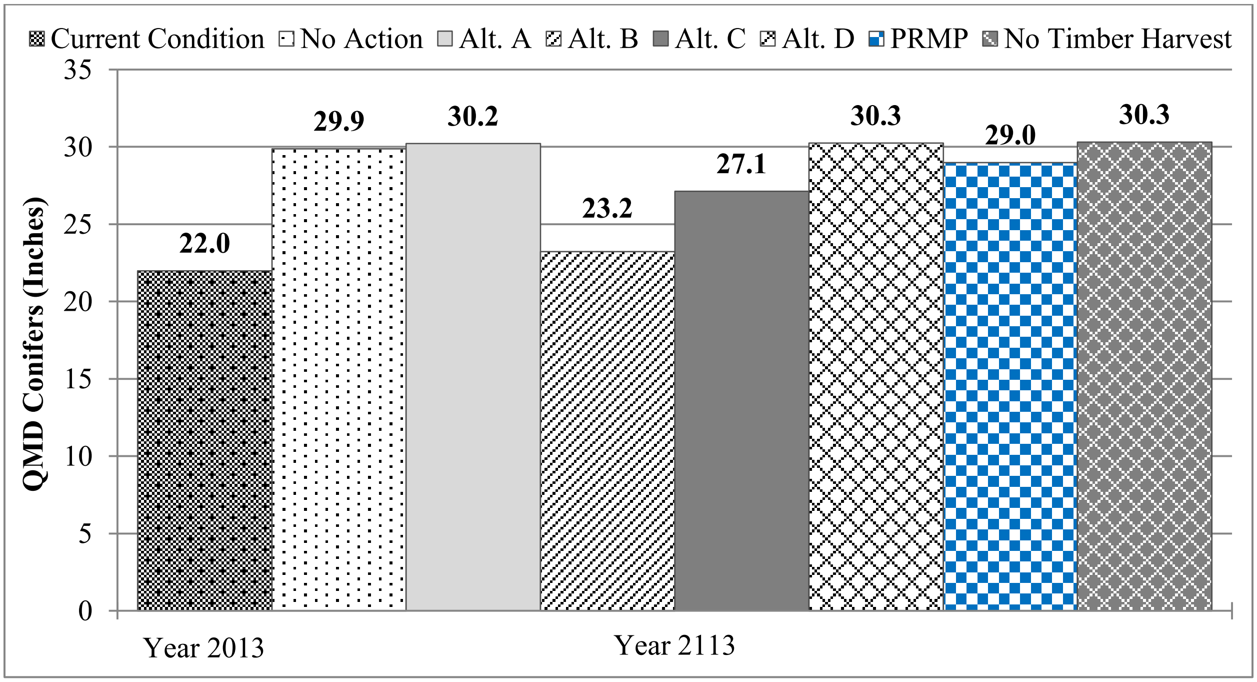

Figure 3-47. Quadratic mean diameter (QMD) of conifers for stands within one site-potential tree height of streams for the current condition in 2013, and in 2113

The trees per acre within one site-potential tree height of streams would decrease substantially from current conditions under all alternatives and the Proposed RMP (**Figure 3-48**); that decrease would be similar under Alternatives A and D and the Proposed RMP, and would be only very slightly less than the decrease under the No Timber Harvest reference analysis. The No Action alternative and Alternatives B and C would result in slightly less decrease in the density of trees in stands within one site-potential tree height of streams. As explained above for the number of large trees near streams, the results shown in **Figure 3-48** display the relative outcomes for total trees per acre near streams over time, but likely overstate the absolute magnitude of the difference in outcomes between Alternatives A and D and the Proposed RMP.

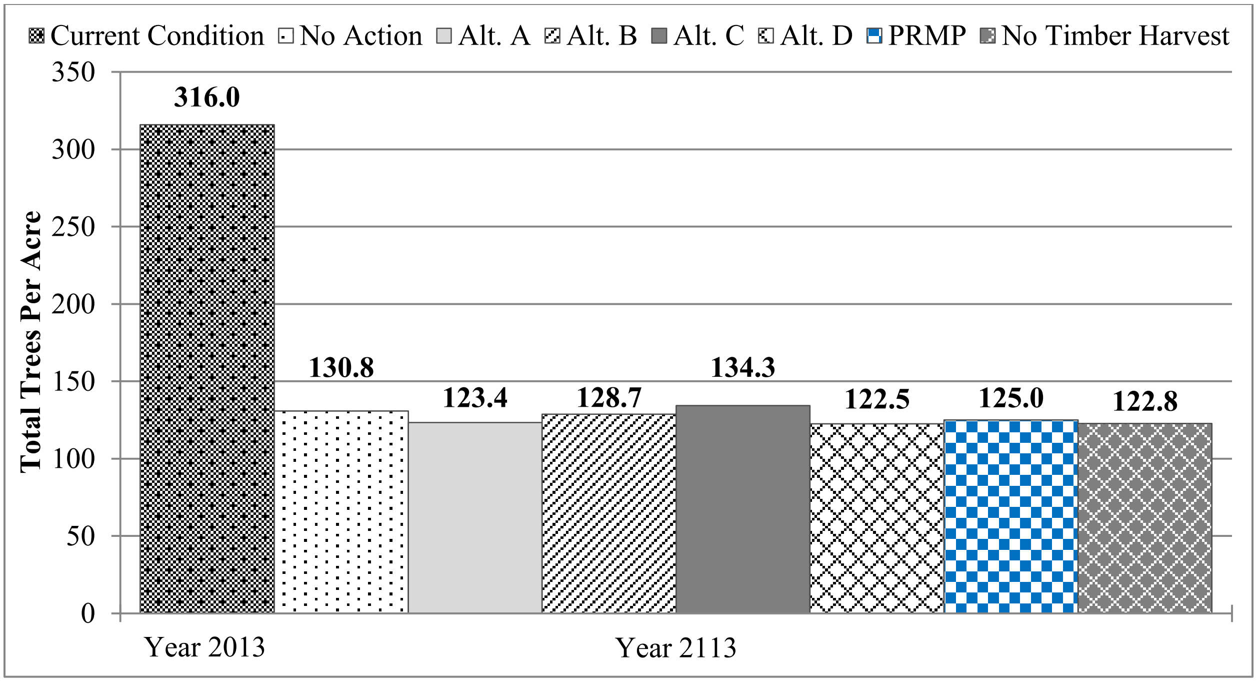

Figure 3-48. Total trees per acre for stands within one site-potential tree height of streams for the current condition in 2013, and in 2113

The similar trends for these stand metrics within one site-potential tree height of streams over time under all alternatives and the Proposed RMP is generally consistent with the analytical conclusion that the overall potential wood contribution from the alternatives would be similar. However, these stand metrics reveals some specific differences among the alternatives and the Proposed RMP in the potential to provide wood to streams.

There are differences in the design of the alternatives that may have differential effects on potential wood contribution that the BLM cannot quantitatively evaluate at this scale of analysis. Notably, the alternatives differ in Riparian Reserve widths, inner zone widths, and management direction for Riparian Reserve thinning.

Riparian Reserve Width

The No Action alternative has wider Riparian Reserve widths on fish-bearing streams than all action alternatives or the Proposed RMP. The No Action alternative and Alternatives A and D have wider Riparian Reserve widths on non-fish-bearing intermittent streams than Alternatives B and C. As a result, the No Action alternative and Alternatives A and D would include within the Riparian Reserve the largest proportion of the landscape capable of delivering wood to the stream. Alternative B would explicitly provide debris-flow-prone non-fish-bearing intermittent streams with a wider Riparian Reserve than other non-fish-bearing intermittent streams. The Riparian Reserve on these debris-flow-prone streams under Alternative B would be narrower than the Riparian Reserve under the No Action alternative and Alternatives A and D, but wider than under Alternative C. Under the Proposed RMP, Riparian Reserve widths in Class I and II watersheds would be the same as Alternatives A and D. In Class III subwatersheds under the Proposed RMP, the Riparian Reserve would be the same width on fish-bearing streams and perennial streams as Alternatives A, B, and D, but the same width on non-fish-bearing intermittent streams as Alternative C. In the various metrics shown above, these differences among the alternatives and the Proposed RMP in Riparian Reserve widths, results in only modest differences in potential wood contribution. It is possible that there would be circumstances in which there could be differences in wood delivery to streams not revealed by this analysis. For example:

- Substantial channel migration could move the stream closer to harvested stands outside of the Riparian Reserve. Under the action alternatives, which would measure the width of the Riparian Reserve from the edge of the active stream channel, this could reduce the potential wood contribution to the stream. This could however be offset in the short term by additional large wood recruited from channel migration. The Proposed RMP would measure the width of the Riparian Reserve from the ordinary high water line, including the channel migration zone for low gradient alluvial shifting channels, which would effectively widen the Riparian Reserve width on streams that would likely experience substantial channel migration compared to the action alternatives. This difference would reduce or eliminate the likelihood that substantial channel migration could move the stream closer to harvested stands outside of the Riparian Reserve under the Proposed RMP compared to the action alternatives.
- Tree fall on extremely steep slopes could result in delivery of wood to non-fish-bearing intermittent streams from beyond 50 feet from the stream. Under Alternatives B and C and in Class III subwatersheds under the Proposed RMP, this could result in fewer trees and smaller diameter wood delivered to some streams if the upslope area includes recently harvested stands outside the Riparian Reserve.
- Debris flows could exceed 100 feet in width. Under Alternative C and in Class III subwatersheds under the Proposed RMP, this could result in fewer trees and smaller diameter wood delivered to streams if the debris flow area along non-fish-bearing intermittent streams includes recently harvested stands outside the Riparian Reserve.

These examples represent exceptional or low-probability circumstances. Furthermore, actual wood loading on streams results from multiple factors and wood delivery from multiple sources, further lowering the probability that any of these exceptional circumstances would result in any discernible difference in actual wood loading in streams at the watershed scale.

Inner Zone Widths

All action alternatives and the Proposed RMP delineate an inner zone near streams in which stand thinning would not occur. Alternatives B and C generally delineate a smaller inner zone than Alternatives A and D and the Proposed RMP. The No Action alternative does not specify any such inner zone. The vegetation modeling of the No Action alternative in this analysis did make assumptions based on recent projects that Riparian Reserve stand thinning would not occur near streams. However, such assumptions about thinning under the No Action alternative are more uncertain than under the action alternatives or the Proposed RMP, given the absence of specific management direction for an inner zone under the No Action alternative. Over time, the wider inner zone along perennial and fish-bearing streams under Alternatives A and D and the Proposed RMP could result in some stands that are capable of delivering wood to streams developing without thinning and thus providing smaller wood available for delivery to streams. Alternatively, the narrower inner zone under Alternatives B and C could result in some stands that are capable of delivering wood to streams being thinned and having fewer trees available for delivery to streams. Identifying any such differences in the influence of differing inner zone widths on potential wood contribution would require stand-specific and stream-specific data coupled with modeling of a specific thinning prescription, which is not possible at this scale of analysis. Nevertheless, using the generalized stand and stream data available, and the modeling assumptions about the extent, location, and prescriptions for thinning, this analysis identified only modest differences in the effect of differing inner zone widths on potential wood contribution to streams.

Management Direction for Riparian Reserve Thinning

The No Action alternative would include thinning for a variety of broad-based ecological purposes, including the nine Aquatic Conservation Strategy objectives. Alternatives B and C and the Proposed RMP in Class II and III watersheds would direct thinning in the outer zone for a differing but comparable set of purposes, including increasing the diversity of riparian species and developing structurally-complex stands. Alternatives B and C, and the Proposed RMP direct that a portion of the trees in stand thinning in the outer zone would be directionally felled to the stream. The Proposed RMP would specifically require a portion of the stand from the inner zone to be felled toward the stream or require a portion of the stand in the outer zone to be made available for instream restoration in order to meet the tree tipping management direction. This would result in more large wood actively being placed in the stream to benefit fish habitat under the Proposed RMP than under the alternatives. Alternatives A and D and the Proposed RMP in Class I subwatersheds would direct thinning in the outer zone as needed for the purpose of ensuring that stands are able to provide stable wood to the stream. Alternative A would generally limit this thinning to non-commercial treatments (i.e., all cut trees would be left in the stand), except in the dry forest, where thinning would also occur as needed for fuels treatments. As with inner zone widths, the management direction under Alternatives A and D, and the Proposed RMP in Class I subwatersheds could result in some stands that are capable of delivering wood to streams developing without thinning and thus providing smaller wood available for delivery to streams. On the other hand, over time, the management direction under the No Action alternative, Alternatives B and C, and the Proposed RMP in Class II and III watersheds could result in some stands that are capable of delivering wood to streams being thinned and having fewer trees available for delivery to streams. As with inner zone widths, identifying any such differences in the influence of differing management direction for riparian thinning on potential wood contribution would require stand-specific and stream-specific data coupled with modeling of a specific thinning prescription, which is not possible at this scale of analysis. Nevertheless, using the generalized stand and stream data available, and the modeling assumptions about the extent, location, and prescriptions for thinning, this analysis identified only modest differences in the effect of differing management direction for thinning on potential wood contribution to streams.

Based on the condition of forest stands in the Riparian Reserve and the management direction in the alternatives, there is a limited acreage of Riparian Reserve stands in the decision area that would be thinned over the next five decades under all alternatives and the Proposed RMP (**Figure 3-49** and **Table 3-45**). The acreages in **Figure 3-49** and **Table 3-45** represent forecasts from the Vegetation Modeling based on modeling assumptions related to the availability of acres suitable for thinning in light of the management direction for each alternative and the Proposed RMP (see **Appendix C**). Because Riparian Reserve thinning under all alternatives and the Proposed RMP would be conducted only for specific stand management purposes and the need for such thinning would depend on stand-specific conditions, these forecasts of the amount and rate of Riparian Reserve thinning are highly approximate. In any decade, the No Action alternative would thin the most Riparian Reserve acres than any action alternative or the Proposed RMP. Alternative D would thin the fewest Riparian Reserve acres. The Proposed RMP would thin an intermediate number of acres of the Riparian Reserve per decade when compared to the No Action alternative and action alternatives.

All alternatives and the Proposed RMP would thin less than 4.2 percent of the Riparian Reserve in any one decade, and the Proposed RMP would thin less than 1.3 percent of the Riparian Reserve in any decade. In total, the Proposed RMP would thin 5.3 percent of the Riparian Reserve over a period of five decades. This very small amount of acres treated under all alternatives and the Proposed RMP supports the analytical conclusion that there would be only modest differences in the effect of differing management direction for thinning on potential wood contribution to streams.

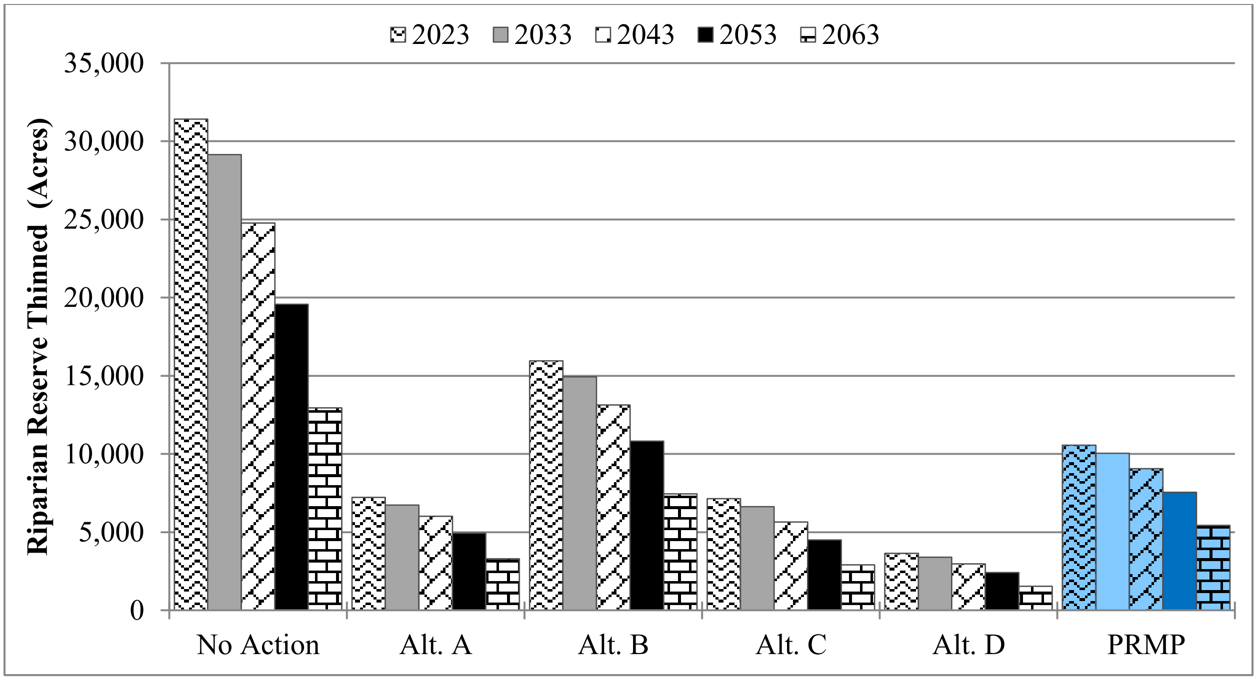

Figure 3-49. Thinning within the Riparian Reserve by decade
Note: Alternative A and the Proposed RMP include non-commercial and habitat enhancement thinning acres

Table 3-45. Thinning within the Riparian Reserve by decade

Decade	No Action (Acres)	Alt. A (Acres)	Alt. B (Acres)	Alt. C (Acres)	Alt. D (Acres)	PRMP (Acres)
2023	31,407	7,219	15,958	7,146	3,655	10,561
2033	29,137	6,731	14,933	6,630	3,405	10,036
2043	24,773	6,017	13,132	5,644	2,961	9,060
2053	19,578	4,944	10,816	4,497	2,424	7,543
2063	12,959	3,289	7,455	2,915	1,542	5,434

The tiered subwatershed approach in the Proposed RMP would result in more protection of Riparian Reserve adjacent to critical habitat and streams with high intrinsic potential. Management direction under the Proposed RMP for tree tipping from inner zones and making available logs or trees for restoration from the outer zone would result in a direct contribution of large wood to streams, in addition to the long-term protection afforded by retention of the no-harvest inner zone.

In summary, the analysis demonstrates only modest differences among the alternatives and the Proposed RMP in the potential wood delivery to streams over time. To the extent that this analysis is able to predict accurately the potential wood contribution, all alternatives and the Proposed RMP would increase the large wood and small functional wood contribution to streams over time. Increases in wood delivery to streams would improve fish habitat by creating deep pools, providing cover, and capturing sediment that provides spawning habitat. Such improvements in habitat would improve fish survival and production and, over time, would contribute to increases in fish populations. The 2008 FEIS described the effects of increasing wood delivery to streams on fish (USDI BLM 2008, pp. 372–374), and that discussion is incorporated here by reference. This analytical conclusion that all alternatives and the Proposed RMP would increase the large wood and small functional wood contribution to streams over time is based on high-quality information using robust analytical methodology and provides an accurate, albeit generalized, description of the effects of the alternatives and the Proposed RMP across the decision area and a sound basis for comparing the alternatives and the Proposed RMP. However, because of the limitations on available data and analytical methodologies and the uncertainties described above, there may be more substantial differences among the alternatives and the Proposed RMP on wood delivery to streams than is apparent in this analysis in some locations and under some circumstances. Such circumstances are exceptional or not conducive to analysis at this scale with the data available. Where such circumstances would be relevant, the BLM would address these site-specific effects on potential wood delivery more fully in the analysis for specific implementation actions.

Issue 2

How would delivery of sediment to fish-bearing and non-fish-bearing streams affect fish under the alternatives?

Summary of Analytical Methods

The delivery of sediment to fish-bearing and non-fish-bearing streams is presented in the Hydrology section. That analysis describes the amount of new road construction and use within a 200-foot delivery distance to streams to estimate the contribution of fine sediment to stream channels.

In this analysis, the BLM assumed that increases in fine sediment less than 1 percent would not result in measurable or meaningful effects on fish survival and that every 1 percent increase in fine sediment from management activities would result in a 3.4 percent decrease in fish survival. The 2008 FEIS summarized the effects of sediment on fish and aquatic habitat and that summary is incorporated here by reference (USDI BLM 2008, pp. 385–388, 799–800). Thresholds for lethal and sub-lethal effects on fish from increases in sediment delivery have not been well established at the scale of this analysis. Cederholm (1981) concluded that there was a 2 percent decrease of egg to emergence survival of salmonids for each 1 percent increase in fine sediment over natural levels at the watershed scale. Suttle *et al.* (2004) suggest there is no threshold below which fine sediment is harmless to fish, and the deposition of fine sediment in the stream channel (even at low concentrations) can decrease the growth of salmonids. Such sub-lethal effects on individual fish would occur under every alternative and the Proposed RMP from timber harvest activities, broadcast burning, grazing, culvert replacements, and other management activities, but it is not possible to describe quantitative changes in sub-lethal effects under the alternatives and the Proposed RMP over time at this scale of analysis. Therefore, this analysis focuses on the sediment levels that would measurably affect fish survival.

Background

Sediment occurs naturally in stream systems and can affect fish directly by increasing turbidity and inhibiting foraging and breathing functions, or indirectly by embedding in stream substrates, thereby reducing macroinvertebrate productivity, or smothering eggs and fry. Fine sediment in streams can affect fish habitat by filling interstitial spaces in gravel substrate, reducing oxygen flow to incubating eggs, and by physically preventing newly hatched fish from emerging. In suspension, fine sediment reduces visibility, reduces foraging ability, and impairs oxygen uptake in gill membranes (Waters 1995).

Affected Environment

In 2009, the Oregon Department of Environmental Quality published an assessment of water quality indicators for forested lands in Western Oregon (ODEQ 2009). The ODEQ modeled sediment using the

PREDATOR model, which uses known preferences and tolerances of aquatic macroinvertebrates to predict stream sediment and other water quality indicators. The model showed that over two-thirds of sites on all Federal lands had less than 10 percent fines, which would be considered ideal for salmonids. Federal lands had the highest percentage of sites in excellent water quality condition, higher than either State or private forestlands (ODEQ 2009).

The ODEQ report summarized conditions by ownership and grouped BLM-administered lands and Forest Service lands into a single category of Federal lands; therefore, conditions may not precisely reflect BLM-administered lands independently. The Willamette region has the highest percent of sites in excellent condition (less than 10 percent fines) with 92 percent, followed by the South Coast with 81 percent, and the North Coast with 69 percent. Although the ODEQ report did not break down the Lower Columbia region by ownership, 81 percent of sites in that region are in excellent condition across all ownerships (ODEQ 2009).

In 2015, the Aquatic and Riparian Effectiveness Monitoring Program, a joint monitoring program of the BLM and Forest Service, released their 20-year monitoring summary, and the analysis and findings contained are incorporated here by reference (Miller *et al.* 2015). That monitoring summary evaluated habitat on Federal lands and found that a majority of watersheds showed an increase in Watershed Condition Scores. In-channel substrate showed an overall positive score indicating that conditions are not only improving but also are trending toward more historical conditions. Substrate scores take into account percent fine sediment, median substrate size, and presence of macroinvertebrates.

Environmental Consequences

Under each of the action alternatives and the Proposed RMP, the estimated amount of additional sediment delivered to streams channels from roads in the first decade would be less than a 1 percent increase from the current amounts (see the Hydrology section in this chapter). At this level, there would be no detectable effect to fish or stream channels from additional sediment. At the site scale, small accumulations of fine sediment could begin to fill pool-tails, or these fines could become embedded in gravel substrates used for spawning. These sediments would be flushed during subsequent high flows and dispersed downstream, where no discernable effect would be detected. Under all alternatives and the Proposed RMP, the increase in fine sediment delivery to streams would not increase more than 1 percent above the current conditions, and would therefore be below the threshold for measurable effects on fish survival at this scale of analysis.

As sediments are flushed from road surfaces, there could be some short-term increases (i.e., lasting several hours) in stream turbidity that would be dispersed within tens to hundreds of feet downstream from the source depending on flow, channel gradient, channel complexity including the amount of woody debris, and other factors (Duncan *et al.* 1987, Gomi *et al.* 2005). This would result in a short-term and localized effect to fish that would elicit non-lethal stress or physical movement out of the stream reach until turbidity levels return to ambient levels. Given that these short-term and localized non-lethal effects on fish would depend on site-specific road conditions, and the total mileage of roads within the sediment delivery distance of streams would vary only slightly among alternatives and the Proposed RMP, there would be no measurable difference in effects from short-term flushing of sediment from road surfaces on fish under any of the alternatives or the Proposed RMP.

Pacific lampreys require sediment accumulations in slow water habitat to complete juvenile rearing. Juvenile lampreys bury themselves in thick sediment deposits where they rear for up to seven years while filter feeding (Luzier *et al.* 2009). Since none of the alternatives of the Proposed RMP would increase sediment contribution above the site level, there would be no measurable difference in effects on Pacific lamprey under any of the alternatives or the Proposed RMP.

Watershed restoration actions, such as log and boulder placement and fish passage improvements that are beneficial to fish habitat, would also result in short-term increases in sediment delivery to stream channels. Removal of culverts and other in-stream structures like blockages would cause stream channel disturbance during summer in-stream operating periods (ODFW 2008). Juvenile fish rearing in these reaches would be displaced moving either upstream or downstream during the time of elevated turbidity and these juveniles would return shortly after disturbance. This could be up to 8 hours in duration and the elevated turbidity could extend tens to hundreds of feet downstream from the site of the disturbance. Application of BMPs (**Appendix J**) would help meet ODEQ water quality standards (see the Hydrology section of this chapter) and further reduce the effects of elevated turbidity on juvenile fish. Additionally, because the BLM does not forecast any difference among the alternatives in watershed restoration actions, there would be no difference in effects on turbidity because of restoration actions under any of the alternatives or the Proposed RMP.

Under all of the alternatives and the Proposed RMP, the effect on stream sediment from livestock grazing would remain the same or decrease. Heavy livestock grazing can consume and trample riparian vegetation and displace soil in riparian and upland areas, potentially creating sources of sediment and reducing the ability of the riparian vegetation to filter sediment. As discussed in the Livestock Grazing section, under all and the Proposed RMP, livestock grazing (acres for grazing, number of allotments, animal unit months, and permittees/lessees) would remain the same or decrease. Under the No Action alternative, Alternatives A, B, and C, and the Proposed RMP, the BLM would manage livestock grazing in accordance with the Standards for Rangeland Health and Guidelines for Livestock Grazing Management for Public Lands in Oregon and Washington (USDI 1997) included in **Appendix L**. Standard #5 of the rangeland health standards (Native, T&E, and Locally Important Species; 1.j.) includes guidance to provide for the life cycle requirements, and maintain or restore the habitat elements of native (including threatened and endangered, Bureau Special Status, and locally important species) and desired plants and animals. This guidance would allow the BLM to restrict the timing of livestock grazing to avoid impacts to ESA-listed fish species and Bureau Sensitive fish species. The BLM assumes the current level of livestock grazing would continue under the No Action alternative, Alternatives A, B, and C and the Proposed RMP (see the Livestock Grazing section of this chapter). Under Alternative D, the BLM would eliminate livestock grazing. Because the BLM would adjust grazing practices under the No Action alternative, Alternatives A, B, and C, and the Proposed RMP as needed to manage livestock grazing in accordance with the rangeland health standards, including maintaining and restoring habitat for threatened and endangered fish species and Bureau Sensitive fish species, the effects of livestock grazing on sediment delivery that could affect fish would be similar to Alternative D at this scale of analysis.

Where livestock grazing would be restricted or eliminated, there would be some recovery of streamside vegetation, which would result in a reduction of stream bank erosion and sediment contribution to streams. This would result in improved spawning substrate for fish through a reduction in fine sediment in gravels. However, at the scale of the planning area, there would be no discernable difference among any of the alternatives or the Proposed RMP in the effects to fish from livestock grazing.

The extraction of minerals on BLM-administered lands adjacent to streams could generate sediment from operations that involve bank excavation with heavy machinery or in-channel suction dredge mining. Operation of heavy machinery and suction dredges for mining within the active channel or floodplain of streams containing ESA-listed fish or critical habitat for ESA-listed fish would result in addition of sediment from stream banks and elevated turbidity from disturbance of the stream bed. The scale and extent of mining is variable and therefore difficult to predict. The amount of sediment generated could result in similar turbidity related stress or effects to the stream by reducing substrate quality for spawning or pool habitat volume. There is no reasonable basis upon which the BLM could predict any difference in these potential effects from mining among the action alternatives, the No Action alternative, or the Proposed RMP at this scale of analysis.

Issue 3

How would the alternatives vary in maintaining stream temperatures for fish-bearing and non-fish-bearing streams?

Background

The 2008 FEIS described the effects of temperature to fish and that discussion is incorporated here by reference (USDI BLM 2008, pp. 388–389). Salmon and steelhead require relatively narrow ranges of temperature at multiple life stages for optimal migration, growth, and reproduction. The Oregon Department of Environmental Quality has defined those ranges in their cold-water protection standards (**Table 3-46**).

Table 3-46. State of Oregon cold-water protection criteria for trout and salmon species

Salmonid Beneficial Use	Criteria
Salmon and Steelhead Spawning	55.4 °F
Core Coldwater Habitat	60.8 °F
Salmon and Trout Rearing and Migration	64.4 °F
Salmon and Steelhead Migration Corridor	68.0 °F
Lahontan Cutthroat Trout or Redband Trout	68.0 °F
Bull Trout Spawning and Juvenile Rearing	53.6 °F

Affected Environment and Environmental Consequences

As stated in the Hydrology section, the riparian management strategies under the No Action alternative and Alternatives A and D and the Proposed RMP would be highly protective of stream shade and would have little risk of increasing stream temperatures. Under these alternatives and the Proposed RMP, less than 0.5 percent of all perennial and fish-bearing reaches in the decision area would be susceptible to shade reductions that could affect stream temperature if the BLM applies thinning in the outer zone of the Riparian Reserve, based on the current condition. However, this limited stream mileage reflects areas with currently low canopy cover in the inner zone, which are the riparian stands least likely to be thinned under the management direction of the No Action alternative, and Alternatives A and D and the Proposed RMP. As discussed in the Hydrology section, this result does not reflect an actual reduction in stream shading, but a susceptibility to such a reduction in stream shading if the BLM thins the outer zone along these streams. If the BLM does not thin the stand in the outer zone, no reduction in stream shading would occur. Even if the outer zone adjacent to inner zone with low canopy cover were thinned, not all of the susceptible reaches would be treated in a given year. In addition, as some stream reaches are treated other stream reaches would recover, reducing the overall effect of canopy removal. This limited stream mileage susceptible to shade reductions would decrease over time as the stands in the inner zone increase in canopy cover. The stream mileage susceptible to shade reductions would decrease to almost zero in 20 years under Alternatives A and D, and the Proposed RMP, and in 30 years under the No Action alternative. Intermittent streams that only flow during colder, generally overcast winter months are much less able to contribute to temperature increases downstream (see the Hydrology section in this chapter). Narrower Riparian Reserve widths on non-fish-bearing intermittent streams under Alternatives B and C and in Class III subwatersheds under the Proposed RMP would therefore not have any measurable effect on stream temperature.

Under Alternatives B and C, approximately 5 percent of fish-bearing and perennial streams would be susceptible to shade reductions that could affect stream temperature if the BLM applied thinning in the outer zone of the Riparian Reserve, based on the current condition. This larger stream mileage does not reflect greater effects of thinning under Alternatives B and C, but a greater susceptibility to shade reductions because of the combination of the current condition of low canopy cover in the inner zone along these streams, combined with the narrower inner zone width under Alternatives B and C. As noted above, areas with low canopy cover in the inner zone are the riparian stands least likely to be thinned under the management direction of Alternatives B and C. Even if the outer zone adjacent to inner zone with low canopy cover was thinned, not all of the susceptible reaches would be treated in a given year. In addition, as some stream reaches are treated other stream reaches would recover, reducing the overall effect of canopy removal. The stream mileage susceptible to shade reductions would decline within the first 20 years under Alternatives B and C, and then would remain relatively constant.

At the stream reach scale, a loss in stream shade that could affect stream heating might result in non-lethal stress for juvenile salmonids rearing (e.g., lowered disease resistance and reduced growth rate) where stream temperatures already exceed ODEQ standards for fish use. However, relatively few miles of streams susceptible to shade reductions that could affect stream temperature are coincident with temperature impaired. Under the No Action alternative, Alternatives A and D, and the Proposed RMP, 30–34 miles of stream reaches in the decision area would be susceptible to shade reductions that could affect stream temperature, and less than 9 percent of these susceptible stream reaches (2.4 miles) overlap temperature impaired reaches. Under Alternatives B and C, 370–372 miles of stream reaches would be susceptible to shade reductions that could affect stream temperature, and about 10 percent of these susceptible reaches (36.8 miles) overlap temperature impaired reaches. Effects from canopy removal would be most noticeable in smaller headwater perennial streams that have a continuous canopy over the channel. Shade reductions on intermittent streams that are dry during the hotter summer months would not result in a measurable increase in stream temperatures or affect fish.

Larger order channels would have a sufficient buffer to temperature increases from the large volume of water that the overall effect on salmonids would be negligible. Additionally, larger streams have more open canopy over the center of the channel and a small reduction in shade would represent a relatively small change in the overall amount of sunlight reaching the steam.

Issues Considered but not Analyzed in Detail

How would peak streamflows affect fish habitat?

The effect of changes in peak streamflows on fish habitat was not analyzed in detail, because the slight changes in peak streamflow susceptibility under the alternatives and the Proposed RMP would not result in any measurable difference in effects on fish habitat. The Hydrology section identifies watersheds that would be susceptible to peak flow increases from rain-on-snow events and evaluated how each of the alternatives would affect the potential for peak flow increases. Atypically high stream flows can modify stream channels by scouring banks and substrate, altering fish habitat. The 2008 FEIS provided a summary of the potential effects of stream flow and peak flows on fish habitat. That discussion is incorporated here by reference (USDI BLM 2008, pp. 390, 800–801). The Hydrology section contains the conclusion that a very small acreage of BLM-administered lands in the planning area would be susceptible to peak streamflow increases under any alternative or the Proposed RMP. Consistent with the conclusions in the 2008 FEIS, there would be no identifiable difference among the alternatives and the Proposed RMP in the effects on fish from peak flow increases for the following two reasons: (1) there is no methodology for detecting differences in effects on fish habitat at this scale of analysis, given the small acreage susceptible to peak flow increases and the relatively small difference in peak flow susceptibility among the alternatives; and (2) the causal connection between watershed susceptibility to increases in peak flow and fish habitat is too speculative and tenuous to describe direct or indirect effects that would differ among the alternatives and the Proposed RMP.

How would stream productivity resulting from nutrient and sunlight influences vary between the alternatives?

The effect of changes in stream productivity was not analyzed in detail, because there would be no measurable difference in effects among the alternatives and the Proposed RMP. In addition to primary productivity, there are other sources of nutrient input and food web stimulus into small fish-bearing streams. Opening the riparian overstory and increasing the available light that reaches the stream can increase primary productivity (Hill *et al.* 1995), hasten breakdown of litter and leaf material (Lagrue *et al.* 2011) and translate to increases in macroinvertebrate and fish biomass (Wootton 2012, Kiffney *et al.* 2014). Fish-bearing stream reaches can receive nutrient influxes from headwater reaches. Both invertebrates and detritus can be exported downstream from non-fish-bearing, headwater reaches year-round and, in turn, support large numbers of juvenile fish (Wipfli and Gregovich 2002). Thinning riparian stands, especially near streams, could potentially increase the primary productivity in streams by increasing sunlight to streams and altering the litter fall composition. All action alternatives and the Proposed RMP would limit near-stream thinning to maintain stream shading. However, Alternatives B and C, which could partially reduce streamside shade, could result in increased primary productivity and growth rates of juvenile salmonids. However, as described above under stream shading, such effects under Alternative B and C are uncertain, and it is not possible to identify any specific change in stream productivity under any of the alternatives or the Proposed RMP.

Historic salmon runs would have also added a large nutrient component to headwater streams that could be utilized by macroinvertebrates and juvenile fish. The ODFW has added spent hatchery carcasses to streams since salmon carcasses could potentially increase growth and abundance of macroinvertebrates that provide forage for juvenile salmonids (Chaloner and Wipfli 2002, Kiffney *et al.* 2014). The addition of salmon carcasses by ODFW could happen under all of the alternatives, and there is no basis for identifying any difference among the alternatives in nutrient inputs to streams.

How would Lost River sucker and shortnose sucker be affected by BLM management actions?

The effects of BLM management on Lost River (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*) were not analyzed in detail, because there would be no measurable difference in effects under the alternatives or the Proposed RMP. The primary effects to Lost River and shortnose sucker adjacent to or downstream of BLM-administered lands on the east side of the Klamath Falls Field Office would be through management of livestock grazing allotments. As noted previously, livestock could trample streamside vegetation and disturb stream banks causing erosion and sediment delivery to adjacent streams. This would reduce spawning substrate quality where fine sediment becomes entrained in gravel and pool habitats by reducing pool volume through deposition of sediment.

Within the decision area, grazing on allotments in the Klamath Falls Field Office would have no effect on Lost River sucker critical habitat. However, where Lost River sucker occupy habitat in the Klamath River, there is potential for grazing to cause an effect in very limited areas where livestock could potentially access the Klamath River.

Four grazing allotments in the Klamath Falls Field Office could adversely affect shortnose sucker or its critical habitat (USDI FWS 2013). The Pitchlog, Dry Prairie, and Horsefly allotments are adjacent to streams designated as critical habitat, and the Paddock allotment is adjacent to Gerber Reservoir, which is designated critical habitat for the shortnose sucker. Together these four allotments comprise 7.5 stream miles and 147.1 acres of critical habitat for shortnose sucker in reservoirs.

Grazing is not a causal factor for non-attainment of Rangeland Health Standards on any of these four allotments. A Rangeland Health assessment found that Pitchlog, Dry Prairie, and Horsefly allotments are meeting or substantially meeting criteria for Riparian/Wetland Areas (see the Livestock Grazing section of this chapter). Water Quality is not being met on any of the three allotments, with summer stream temperature exceeding state standards. However, the causal mechanism for elevated water temperature is regulation of the upstream Gerber Reservoir, over which the BLM has no control. Grazing practices specifically are not considered a factor in the non-attainment of the standard (USDI FWS 2013). The Paddock allotment is meeting both Riparian and Wetland Areas and Water Quality Rangeland Health Standards (USDI BLM 2003).

As described above, the BLM would eliminate livestock grazing under Alternative D and would manage livestock grazing under all other alternatives and the Proposed RMP in accordance with the Standards for Rangeland Health and Guidelines for Livestock Grazing Management for Public Lands in Oregon and Washington (USDI 1997) included in **Appendix L**. This guidance would allow the BLM to restrict the timing of livestock grazing to avoid impacts to Lost River sucker and shortnose sucker. Because the BLM would adjust grazing practices under the No Action alternative, Alternatives A, B, and C, and the Proposed RMP as needed to manage livestock grazing in accordance with the rangeland health standards, including maintaining and restoring habitat for threatened and endangered species, the effects of livestock grazing on Lost River sucker and shortnose sucker would be similar to Alternative D at this scale of analysis.

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